Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 5 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

Effect Of Pnf-Based Core Stabilization On Pain Intensity And Functional Disability In Chronic Low Back Pain Patients.

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ABSTRACT

Chronic low back pain (CLBP) describes a musculoskeletal impairment that last longer than 12 weeks and that is the irritation to the anatomical site below the posterior ribs and above the lower margins of buttock.It can also present as repeated episodes, arising two or more times per year, each duration longer than 24 hours, with symptom-free periods of at least 30 days between episodes. The aim of conducting this research was to see the effects of PNF based core stabilization on pain intensity and functional disability in chronic low back pain patients. This study was Quasi experimental study in which convenient sampling technique were used. 45 participants with age of 30-50 were included on basis of inclusion criteria from public and private hospitals of Faisalabad. Patients received treatment protocol PNF based(hold-relax) abdominal muscle training for 6 weeks. The treatment was given for 3 times per week for consecutive 6 weeks. Measurements were taken after 3rd weeks and 6^{th} week. By using repeated measures ANOVA test analysis that there is a statistically significant improvement with p-value of <0.001 in pain and functional disability index. It was concluded that PNF (hold relax) based core stabilization exercises shown to be effective in CLBP patients.

Key Words: Core Stabilization, Chronic Pain, Low Back Pain, Musculoskeletal Disorder, Numeric Pain Rating Scale, Oswestry Disability Index, Proprioceptive Neuromuscular Facilitation Technique

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INTRODUCTION:

Low back pain is emerged as one of the leading cause of long term disability. Although the majority of people with acute low back pain relieve within a short time, a small amount—between 4% and 25%—progress to chronic pain.(Nieminen et al., 2021).Globally, about 10% of the population is suffering from low back pain at any moment, and most people—between 70% and 85%—will experience it at some point in their lives. At the end, economic consequences are notable for individuals and society as a whole.(Hussain et al., 2016).Regional musculoskeletal pain (MSP) is usually reported among working adults(Herin et al., 2014). Low back pain (LBP) is a common health issue in industrialized populations and continues to be the major reason of disability globally. LBP affects both physical performance and social participation, limiting movement, affecting daily activities, and minimizing quality of life and economic well-being(Arcanjo et al., 2022).Disability is an important result of chronic low back pain (CLBP). Back pain issue that lasts for at least three months and has resulted in pain on minimum half the days in the past 6 months(Russo et al., 2018). Chronic low back pain (CLBP) is marked by discomfort, pain, muscle tightness, or stiffness in the lower back that persist for more than 12 weeks. Disability is a key result of CLBP(Jurak et al., 2025).Approximately 40% of people develop low back pain that becomes chronic, lasts for at least 12 weeks(Park, 2021).The lumbar region of the spine shows an inward(concave) curvature known as lumbar lordosis, which is different in magnitude among individuals. This natural curve helps shift the weight of the upper body onto the pelvis, supporting effective upright posture and bipedal locomotionThree major muscle groups are linked with the lumbar spine and facilitate its movement. One important group is the posterior extensor muscles, that consist of erector spinae and multifidus(Sassack & Carrier, 2023). Low back pain can originate from three major types of origins: axial lumbosacral, radicular, and referred pain(Urits et al., 2019).In CLBP, strengthening the core muscles play an important role for lumbar and trunk stability, that help in pain relief and improved spinal function(Li et al., 2025). Proprioceptive Neuromuscular Facilitation (PNF) is a therapeutic technique that combines fundamentals of motor control and motor learning.Proprioceptive Neuromuscular Facilitation (PNF) is an exercise method that improves neuromuscular control through proprioceptor stimulation. Research shows that PNF is effective for patients with chronic low back pain (CLBP) by reducing pain, improving functional capacity, enhancing postural control and trunk stability, increasing lumbar and hip flexibility, and promoting trunk muscle activation.(Anggiat et al., 2022).In chronic low back pain (CLBP), PNF techniques are used with the aims of improving muscular strength, increasing range of motion, and enhancing overall functional activity. When applied to the abdominal muscles in a supine position, PNF supports in developing muscle endurance, increase flexibility, and helps in improving functional capacity in individuals with CLBP. Furthermore , introducing PNF on lower-extremity patterns can increase core muscle activation, results in improved stability and spinal control(Baig & Ansari, 2022).Exercises for core stabilization can be effective for populations with LBP, especially for those with chronic LBP(Stuber et al., 2014).Through PNF(hold relax) based core strength exercise, chronic low back pain patients can strengthen their deep trunk muscles that decrease pain and functional disability score(Kapetanovic et al., 2016).PNF especially hold relax technique play a

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significant role in treating low back pain. The PNF approach may assist local joint control and muscle sensitivity by enhancing the sensitivity of muscle spindle and Golgi tendon organs, which play a crucial role in proprioception(McCaskey et al., 2018).Basic protocols of PNF, such as rotational patterns of movement and different protocols, including rhythmic stabilization, dynamic reversals, combination of isotonic, repeated contractions, and contract-relax, can be implemented to improve flexibility, muscle strength, and movement. So , the concept of PNF is to facilitate joint coordination, muscle strength, movement control, stability, and mobility(Arcanjo et al., 2022). Proprioceptive neuromuscular technique is most effective technique to relieve chronic lower back pain and functional disability index than any other techniques like muscle energetic technique(MET), McKenzie etc(Patel et al., 2022).

MATERIAL AND METHDOLOGY:

In present study we aimed to find the effect of PNF(hold-relax) based core stabilization in chronic low back pain patients to accomplish this outcome. 45 participants from physical therapy and orthopedic OPD from public and private hospitals of Faisalabad in this study. All subjects were informed with written consent before the participation.

Researcher used convenient sampling technique for data collection. A deep study of history and physical examination were carried out.

Inclusion criteria: was the subjects from both gender in the age group of 30-50years diagnosed chronic low back pain patients, baseline pain intensity ≥3/10 on Numeric Pain Rating Scale (NPRS), oswestry Disability Index (ODI) score ≥20%, pain more than 12weeks. **Exclusion criteria:** The subjects having any physical traumatic case (falls, accidents), congenital deformities, cancer, systemic infection and pregnancy, neurological disease affecting trunk control (e.g., multiple sclerosis, recent stroke), sacroiliac joint disorder were excluded out. **Study design:** Quasi experimental study
Sampling technique: Convenient sampling technique were used. **Sample size:** n= 45participants.

Data analysis:

All data related to study were tested for normal distribution by using repeated measure ANOVA test. SPSS-23 version(Statistical package for social sciences) were used to analyze the data. p value of <0.001 was considered to be statistically significant.

RESULTS:

Effect of PNF based core stabilization exercise on pain intensity and functional disability in chronic low back pain patients was determined in this study. By using repeated measure ANOVA test analyze that there is significantly improvement $p<0.001$ in pain intensity and disability of study members are described in Tables.

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TABLE 1: Frequency distribution table of gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	MALE	14	31.1	31.1	31.1
	FEMALE	31	68.9	68.9	100.0
	Total	45	100.0	100.0	

The frequency distribution of participant's gender shows that the sample is mostly female dominated with 31.1% identifying as females and 68.9% identifying as males showing a modest skew towards female responde

TABLE 2:

GENDER

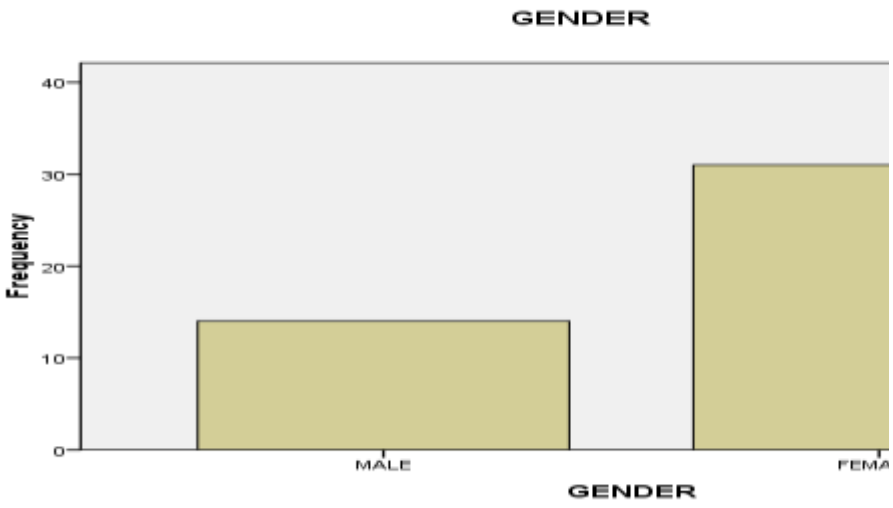
N	Valid	45
	Missing	0
Mean		1.69
Median		2.00
Mode		2
Std. Deviation		.468

The mean gender score is 1.69 while the median and mode are both 2.0. Assuming a code where 1 represent male and 2 represent female, the median and mode suggest that most participants are females.

GRAPH 1:

The chart indicates higher number of females participants compared to males.While both genders are well represented, females make up the majority in the sample.

TABLE 3:



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AGE

N	**Valid**	**45**
	Missing	**0**
Mean		**2.27**
Median		**2.00**
Mode		**1**
Std. Deviation		**1.074**

The mean age score is 2.27. while the median is 2 and mode is 1, suggesting that most common and central age category among participants is 1.Overall, the data appeared concentrated around the central value.

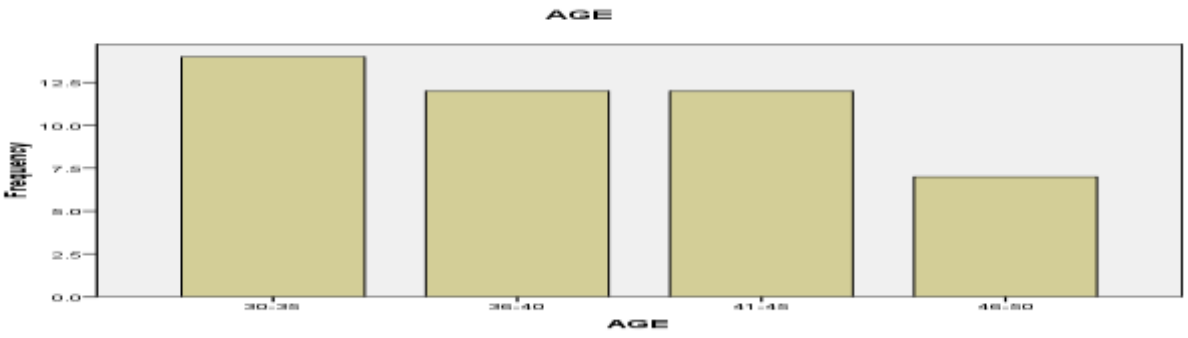
TABLE 4:Frequency distribution table of age

AGE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**30-35**	**14**	**31.1**	**31.1**	**31.1**
	36-40	**12**	**26.7**	**26.7**	**57.8**
	41-45	**12**	**26.7**	**26.7**	**84.4**
	46-50	**7**	**15.6**	**15.6**	**100.0**
	Total	**45**	**100.0**	**100.0**	

Most participants (31.1%) are aged between 31-35, followed by 26.7% in the both 36-40 and 41-45 age groups. Few participants are older than 45, indicating a predominantly adult sample.

GRAPH 2: Age of participants



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The bar chart visually confirms that most participants fall in the 30-35 age group, with both 36-40 and 41-45 being the next most common. The 46-50 has significantly fewer participants, highlighting a skew towards early thirties.

Table# 5: descriptive statistics of pain and disability

Variables	N	Mean	95% confidence interval		Std. Deviation	Stand Error
			Lower boundary	Upper boundary		
Pain pre	45	2.56	2.405	2.707	.503	0.75
Pain post 3	45	2.09	2.002	2.175	.288	0.43
Pain post 6	45	1.56	1.405	1.707	.503	0.75
ODI pre	45	2.91	2.732	3.090	.596	0.89
ODI post 3	45	2.33	2.141	2.525	.640	0.95
ODI post 6	45	1.49	1.337	1.641	.506	0.75

The table show a progressive reduction in pain scores across the three assessment points. The mean pain score before intervention was 2.56 ± 0.503, which decreased to 2.09 ± 0.288 after 3 weeks of intervention and further reduced to 1.56 ± 0.503 after 6 weeks of intervention. This mean difference suggests that PNF-based abdominal muscle training significantly reduced pain intensity over time in patients with chronic low back pain.The chart for disability show a decreasing trend in mean scores over time. The mean value of disability was 2.91 ± 0.596 before intervention, which decreased to 2.33 ± 0.640 after 3 weeks of intervention and further reduced to 1.49 ± 0.506 after 6 weeks. The mean difference indicates a considerable reduction in disability over time, suggesting that the intervention improved functional outcomes in participants.

Table#6: ANOVA test statistics

Variable	Mauchly p	Correction	F	df	Partial Eta Squared	p
Pain	.955	Sphericity assumed	86.465	2	.663	.000
ODI	.493	Sphericity assumed	152.455	2	.776	.000

The repeated measures ANOVA showed a statistically significant effect of PNFbased abdominal muscle training on pain scores among chronic low back pain patients, with $F=86.465$, $p<0.001$, with a large effect size (Partial $\eta^2=0.663$). Mauchly's test of sphericity was non-significant ($p=0.955$), indicating that the assumption of sphericity was met.The repeated measures ANOVA showed a statistically significant effect of

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PNFbased abdominal muscle training on pain scores among chronic low back pain patients, with F=152.455, p<0.001, with a large effect size (Partial η^2=0.776). Mauchly's test of sphericity was non-significant (p=0.493), indicating that the assumption of sphericity was met.

TABLE 7: Repeated measure ANOVA statistical analysis of pairwise comparison of pain

(I) PAIN	(J) PAIN	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1(PRE)	2(POST3)	.467*	.075	.000	.279	.654
	3(POST6)	1.000*	.078	.000	.806	1.194
2(POST3)	1(PRE)	-.467*	.075	.000	-.654	-.279
	3(POST6)	.533*	.075	.000	.346	.721
3(POST6)	1(PRE)	-1.000*	.078	.000	-1.194	-.806
	2(POST3)	-.533*	.075	.000	-.721	-.346

The chart shows a significant difference in pain scores across all time points. Pairwise comparisons showed that pain significantly decreased from baseline to 3 weeks (mean difference=0.467, p < 0.001), baseline to 6 weeks (mean difference=1.000, p < 0.001), and also from 3 weeks to 6 weeks (mean difference=0.533, p < 0.001). The largest reduction in pain is seen between baseline and 6 weeks. These readings indicate that the intervention is effective in progressively reducing pain over time.

These findings demonstrate that there was a statistically highly significant reduction in pain over the course of the intervention, suggesting that PNF-based abdominal muscle training had a substantial positive effect on pain outcomes in chronic low back pain patients.

TABLE 8: Repeated measure ANOVA statistical analysis of pairwise comparison effects of disability

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(I) DISABILITY	(J) DISABILITY	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1(PRE)	2(POST3)	.578*	.074	.000	.392	.763
	3(POST6)	1.422*	.087	.000	1.206	1.639
2(POST3)	1(PRE)	-.578*	.074	.000	-.763	-.392
	3(POST6)	.844*	.084	.000	.636	1.053
3(POST6)	1(PRE)	-1.422*	.087	.000	-1.639	-1.206
	2(POST3)	-.844*	.084	.000	-1.053	-.636

This table shows significant difference in disability index scores across all time points. Pairwise comparisons revealed that disability index significantly decreased from baseline to 3 weeks (mean difference=0.578, $p < 0.001$), baseline to 6 weeks (mean difference=1.422, $p < 0.001$), and also from 3 weeks to 6 weeks (mean difference=0.844, $p < 0.001$). The largest reduction in disability index is observed between baseline and 6 weeks. These readings indicate that the intervention is effective in progressively reducing disability index over time.

DISCUSSION:

According to data interpretation it is concluded that there is effect of PNF (hold relax) based core stabilization exercises on pain and functional disability index in chronic low back pain(CLBP) patients as p-value is <0.001. Majority of chronic low back pain patients experienced functional disability in their routine chores. Females are more prone to chronic low back pain as compared to males. Out of 45 members 31 were female patients and 14 were male patients. This implies that chronic low back pain is more pervasive in female patients than male patients.69% are females and just 31% are males. Age of patient's shift between 30 years to 50 years. The results showed significant difference in pain of selected population of chronic low back pain before, post 3 weeks and post 6 weeks intervention that the pain decreases after the treatment session with p-value < 0.001. The results of this study also showed difference in the mean of functional disability index between intervals before, post 3 weeks and post 6 weeks of intervention. There is a significant difference in means of pre and post 3 weeks and post 6 weeks intervention of functional disability index with p-value of < 0.001 in chronic low back pain patients.Comparison of the numeric pain rating scale rating in chronic low back pain patient before the treatment, mid the

Online ISSN 3007-3197
Print ISSN 3007-3189

treatment and after the treatment also showed improved score on numeric pain rating scale after the treatment showed significant difference as p-value <0.001.Also comparison of oswestry disability index questionnaire in chronic low back pain patients before the treatment, mid the treatment and after the treatment also showed improved score on oswestry disability index questionnaire after the treatment showed significant difference as p-value <0.001.The progressive improvement in disability index readings shows that strengthening and neuromuscular re-education of the abdominal muscles enhance functional movements in CLBP patients. Improvement in core stability improves posture, balance, and movement efficiency, thus reduction in activity restrictions and participation limitation in daily life. Many studies suggested that enhanced lumbar stability may contribute to the decrease in pain experienced by LBP patients. Hold-relax PNF programs, by improving proprioception, appear particularly beneficial for managing pain in chronic low back pain (CLBP)(Pourahmadi et al., 2020).PNF technique specially hold relax technique significantly improve pain and functional disability in chronic low back pain patients and help the patient to maintain normal daily life activities.PNF especially hold relax works significant to decrease pain as many studies support it. Low back pain is associated with decreased proprioceptive input and impaired neuromuscular control so, proprioceptive neuromuscular facilitation (PNF)is a therapy that uses sensory, visual and verbal sources to enhance the neuromuscular responses. It helps patient to boost coordination, enhance their stability, range of motion and can alleviate pain through relaxation(Poojitha et al., 2025).the comparative effects of core stabilization exercises (CSE) and PNF training on pain and neuromuscular outcomes in individuals with chronic low back pain (CLBP)(P. Areeudomwong & V. Buttagat, 2019).Kaljić et al. found that treatment(PNF) with core stabilizing exercises leads to improvement in patients with chronic low back pain patients(Kapetanovic et al., 2016). PNF pattern has been used in the management of rehabilitation programs, which includes the theory of irradiation from peripheral to central muscles(Baig & Ansari, 2022).PNF emphasizes the overall movement of multiple joint proprioceptors and multiple trunk muscle groups rather than the movement of a single muscle, and thus PNF played a positive role in pain relief and waist functional improvement in chronic low back pain.(Gao et al., 2022).PNF controls proprioception and sensory motor function. PNF exercises enhance muscle strength, flexibility, endurance, and ability to perform life activities(Koutarapu & Ghumare, 2022). Many clinicians use PNF combination with other techniques but in this study, we used PNF especially hold relax alone to see it's effect and it produce very significant results to reduce pain and functional disability index.Proprioceptive neuromuscular facilitation training that are performed 3 times a week for at least 4 weeks in CLBP patients and conclude a remarkable improvement in ODI before and after the treatment(Kim & Lee, 2017).Proprioception training are used in clinical practice as it is beneficial for reducing pain and improving quality of life(Lee & Chen, 2024). Proprioceptive neuromuscular facilitation techniques make use of their subjective stimulation for the strengthening (facilitation) or relaxation (inhibition)of muscle groups. So, this study has shown that PNF can increase flexibility and improve range of motion as well (Zaidi et al., 2023). The principles of motor learning and motor control in his PNF treatment to reach the highest functional level and to increase the quality of

Online ISSN 3007-3197
Print ISSN 3007-3189
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life(Nikolova et al., 2022).It is verified that proper Proprioceptive neuromuscular facilitation (PNF) have no serious adverse effects in patients with chronic low back pain and relieve pain and improve individual activities of the daily life .It was reported that PNF especially hold relax promote neuromuscular responses through stimulating proprioceptors ,improving the muscular strength, joint mobility, promote neuromuscular control, and coordination ,consequently improving the overall functional ability of patients with chronic low back pain(CLBP)(Ling-Xin et al., 2022). Quality of life is considered to be synonymous with the health status, physical functioning, perceived health status, subjective health, well-being, and functional disability, therefore the current study aims to synthesize the existing empirical evidence on the determinant of quality of life in individuals having chronic low back pain(Agnus Tom et al., 2022). PNF proves to be most effective for rehabilitation of patients because exercise is the most current and frequently used modality for targeting and gaining muscle strength and endurance with the flexibility of back muscles and soft tissue and help to relieve lower back pain and to restore the normal life activities(Fouda et al., 2021).

CONCLUSION:

The conclusion of PNF based core stabilization exercises on chronic low back pain patients showed that PNF has more beneficial effects in relieving pain and improving the functional status of patients with chronic LBP in the short term of 1-3 week intervention and it remained a positive role at 6th-week follow-up.

Conflicts of Interest:

No potential conflict of interest

Funding detail:

Not received any funding from any resource

Acknowledgement:

First and foremost, all the appreciation to the Allah Almighty and His Rasool (S.A.W). Without His blessings and mercy, we are nothing. We extremely thankful to our parents and teachers for their guidance and inspiration.

Ethical considerations:

Informed consent was obtained from all participants before data collection. All participant were informed about purpose, benefits, procedure and possible risk of the study. Privacy of participants were maintained. Participation was voluntary and participants has right to withdraw from study at any time without penalty. No physical harm was caused to patients during the study. Equal treatment and respect were provided to all the participants.

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